Data Evaluation Record on the Acute Toxicity of Avenger Weed Killer Concentrate (a.i. d-limonene) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49098302**

Data Requirement:

PMRA Data Code:	9.8.4 (TGAI) or 9.8.6 (EP)
EPA DP Barcode:	411395
OECD Data Point:	IIA 8.12 (TGAI) and IIIA 10.8.1.1 (EP)
EPA Guideline:	850.4150

Test material: Limonene **Purity:** 70%
Common name
Chemical name: IUPAC:
CAS name:
CAS No.:
Synonyms:

Primary Reviewer: Joan Gaidos **Signature:**
Environmental Scientist, CDM Smith **Date:** 2/24/14

Secondary Reviewer: Teri S. Myers **Signature:**
Environmental Scientist, CDM Smith **Date:** 03/05/14

Primary Reviewer: Katherine Stebbins **Date:** 09-09-14 Katherine Stebbins
OPP/EPA/ERB3

EPA PC Code 079701

Date Evaluation Completed: 09-09-14

CITATION: Younger, C. 2012. Avenger Weed Killer Concentrate Terrestrial Plant Toxicity, Vegetative Vigor. Unpublished study performed by Stillmeadow, Inc., Sugar Land, Texas. Laboratory Project Number: 16474-12. Study sponsored by Cutting Edge Formulation, Buford, Georgia. Study completed January 13, 2013.

DISCLAIMER: This document provides guidance for EPA and PMRA reviewers on how to complete a data evaluation record after reviewing a scientific study concerning the acute toxicity of a pesticide to terrestrial vascular plants. It is not intended to prescribe conditions to any external party for conducting this study nor to establish absolute criteria regarding the assessment of whether the study is scientifically sound and whether the study satisfies any applicable data requirements. Reviewers are expected to review and to determine for each study, on a case-by-case basis, whether it is scientifically sound and provides sufficient information to satisfy applicable data requirements. Studies that fail to meet any of the conditions may be accepted, if appropriate; similarly, studies that meet all of the conditions may be rejected, if appropriate. In sum, the reviewer is to take into account the totality of factors related to the test methodology and results in determining the acceptability of the study.

Data Evaluation Record on the Acute Toxicity of Avenger Weed Killer Concentrate (a.i. d-limonene) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49098302**

EXECUTIVE SUMMARY:

The effect of **Avenger Weed Killer Concentrate (d-limonene, 70%)** on the vegetative vigor of monocot (corn, *Zea mays*; onion, *Allium cepa*; ryegrass, *Lolium perenne*; and oat, *Avena sativa*) and dicot (cabbage, *Brassica oleracea*; carrot, *Daucus carota*; cucumber, *Cucumis sativus*; soybean, *Glycine max*; lettuce, *Lactuca sativa*; and tomato, *Lycopersicon esculentum*) crops was studied at a nominal concentration of 0 (negative), 6.4, 13, 26, 51, and 103 lb ai/A. Measured concentration for cabbage were 7, 10, 30, 54, and 85 lb ai/A; carrot were 6, 13, 25, 71, and 109 lb ai/A; corn were 8, 13, 31, 79, and 101 lb ai/A; cucumber were 7, 15, 28, 62, and 79 lb ai/A; lettuce were 7, 13, 31, 61, and 128 lb ai/A; oat were 15, 18, 25, 71, and 153 lb ai/A; onion were 6, 14, 33, 39, and 87 lb ai/A; ryegrass were 6, 12, 24, 47, and 115 lb ai/A; soybean were 7, 9, 25, 41, and 69 lb ai/A and tomato were 7, 13, 30, 52 and 58 lb ai/A.

The growth medium used in the seedling emergence test was peat pellets (not characterized). On day 14 the surviving plants per pot were recorded and cut at soil level for measuring the plant height and dry weight.

Negative control survival ranged from 97 to 100%. All species had 100% inhibition at the highest test concentration, with the exceptions of lettuce (89% inhibition), oat (18% inhibition), and onion (72% inhibition) compared to the negative control ($p<0.05$). Reductions in survival for ryegrass, corn and oat began at 25/31 lb ai/A; for cucumber and lettuce at 61/62 lb ai/A; for cabbage at 54 lb ai/A; and for carrot at 71 lb ai/A (Spearman-Karber; $p<0.05$). There was also a significant reduction in onion at 87 lb ai/A (72% inhibition; Spearman-Karber; $p<0.05$). The only effect on survival for tomato was complete mortality at the 58 lb ai/A test level (Mann-Whitney; $p<0.05$). There were no significant effects on mortalities in soybean, however there was a significant effect on phytotoxicity scores at the highest test concentration ($p<0.05$; calculated by the study author).

There were significant dose-dependent responses in height compared to the negative controls beginning at the 7 lb ai/A test level for cucumber; beginning at 10/13 lb ai/A for cabbage, carrot and corn; and beginning at 24 lb ai/A for ryegrass (William's; $p<0.05$). There were significant non monotonic reduction in height compared to the negative controls beginning at 7 lb ai/A for lettuce, and beginning at 25 lb ai/A for oat (Dunnett's test; $p<0.05$). There was a significant reduction in height for onion at the 87 lb ai/A test level (97% inhibition; Dunnett's test; $p<0.05$) and for soybean at the 69 lb ai/A test level (52% inhibition; Mann-Whitney Wilcoxon test, $p<0.05$) compared to the negative control; however these effects may have been related to very poor survival at those treatment levels. There was no significant response in height for tomato; however all tomato seedlings died at the highest test level.

There were significant dose-dependent responses in weight compared to the negative controls beginning at the 7/8 lb ai/A test level for cabbage, corn, cucumber and soybean; and beginning at 13 lb ai/A for carrot (William's; $p<0.05$). There was a significant reduction in weight for lettuce at the 7 lb ai/A test level (48% inhibition); oat at the 71 lb ai/A test level (62% inhibition); and onion at the 87 lb ai/A test level (79%; Dunnett's test; $p<0.05$). There was a significant reduction for ryegrass at the 24 and 47 lb ai/A test levels (64% and 53% inhibition, respectively; Dunnett's test; $p<0.05$). There was no significant response in height for tomato; however all tomato seedlings died at the highest test level.

The most sensitive monocot was corn, based on dry weight, with NOAEC and EC_{25} values of <8 lb ai/A, and 2.83 lb ai/A, respectively. The most sensitive dicot was cabbage, based on dry weight, with NOAEC and EC_{25} values of <7 lb ai/A, and 7.09 lb ai/A, respectively

Based on the phytotoxicity rating system used by the study author, there were significant responses for all species that mirrored the survival data. There were no significant effects on negative controls or at any treatment level for any of the species studied.

Data Evaluation Record on the Acute Toxicity of Avenger Weed Killer Concentrate (a.i. d-limonene) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49098302**

Maximum Labeled Rate: Not reported

Results Synopsis

Most sensitive monocot: Corn, based on dry weight

EC_{50}/IC_{50}: 18.6 lb ai/A	95% C.I.: 9.56-36.3 lb ai/A
EC_{25}/IC_{25}: 2.83 lb ai/A	95% C.I.: 0.21-12.7 lb ai/A
EC_{05}/IC_{05}: 0.19 lb ai/A	95% C.I.: N/A-3.07 lb ai/A
NOEC: <8 lb ai/A	
Slope: N/A	95% C.I.: N/A

Most sensitive dicot: Cabbage, based on dry weight

EC_{50}/IC_{50}: 22.9 lb ai/A	95% C.I.: 15.9-33.1 lb ai/A
EC_{25}/IC_{25}: 7.09 lb ai/A	95% C.I.: 3.37-12.6 lb ai/A
EC_{05}/IC_{05}: 1.31 lb ai/A	95% C.I.: N/A-4.87 lb ai/A
NOEC: <7 lb ai/A	
Slope: N/A	95% C.I.: N/A

This toxicity study is classified as ACCEPTABLE and satisfies the guideline requirement for an acute terrestrial plant toxicity study.

Table 1 (Tier II studies). Summary of most sensitive parameters by species (lbs ai/A).

Species	Endpoint	NOEC	EC_{05}	EC_{25}	EC_{50}
Cabbage	Dry weight	<7	1.31	7.09	22.9
Carrot	Dry weight	6	4.5	12.2	24.3
Corn	Dry weight	<8	0.19	2.83	18.6
Cucumber	Dry weight	<7	0.457	7.3	50
Lettuce	Height	<7	0.312	8.3	81.2
Oat*	Dry weight	25	0.156	21.8	>152
Onion*	Dry weight	39	28.3	42.8	57.1
Ryegrass*	Dry weight	12	2.87	11.5	30.1
Soybean	Dry weight	<7	21.4	40.8	63.9
Tomato*	Survival	52	>58	>58	>58

* The response was not dose-dependent; NOEC and/or ECx values are unreliable.

I. MATERIALS AND METHODS

GUIDELINE FOLLOWED: This study was conducted in compliance with OCSPP 850.4150: Terrestrial Plant Toxicity, Tier II (Vegetative Vigor), April 1996. The reviewer evaluated the study methods according to EPA Ecological Effects Test Guidelines, OCSPP Guideline 850.4150: Vegetative Vigor. Deviations were noted by the reviewer.

1. The study was conducted using peat pellets, which were not characterized. U.S.EPA guidance prefers the study be conducted using a soil that is adequately characterized.

2. The physiochemical properties of the test material were not reported.

3. The purity of the test material active ingredient was not confirmed.

4. The maximum label rate for Avenger Weed Killer Concentrate (70% d-limonene) was not reported.

5. Germination rates were not reported. USEPA recommends germination rates of 70% or higher.

The deficiency and deviations did not have an impact on the acceptability of this study.

COMPLIANCE: Signed and dated GLP, Quality Assurance and Data Confidentiality statements were provided. This study was conducted in compliance with FIFRA Good Laboratory Practice Standards as published by the U.S. EPA, 40 CFR Part 160 (1989).

A. MATERIALS:

1. Test Material **Avenger Weed Killer Concentrate (d-limonene, 70%)**

Description: Slightly yellow liquid

Lot No./Batch No.: B186

Purity: 70% (purity was not confirmed).

Stability of compound under test conditions: Analytical determinations based on measured concentration of the test material in the spray solution was not reported. Stability was not reported.

(OECD recommends chemical stability in water and light)

Storage conditions of test chemicals: The test material was stored at room temperature.

Table 2. Physical/chemical properties of Avenger Weed Killer Concentrate (Limonene).

Parameter	Values	Comments
Water solubility at 20˚C	Not reported	
Vapor pressure	Not reported	
UV absorption	Not reported	
pKa	Not reported	
Kow	Not reported	

2. Test organism: The variety of each species used was not reported.

Monocotyledonous species: Corn (*Zea mays*, Poaceae; Illini Xtra-Sweet), Onion (*Allium cepa*, Liliaceae; Cipponlina Borretana), Ryegrass (*Lolium perenne*, Poaceae; Perennial ryegrass), and Oat (*Avena sativa*, Poaceae; Hulless oats); *EPA recommends four monocots in two families, including corn.*
Dicotyledonous species: Carrot (*Daucus carota*, Apiaceae; Big Top), Cabbage (*Brassica oleracea*, Brassicaceae; Brunswick), Soybean (*Glycine max*, Fabaceae; Green soybean), Lettuce (*Lactuca sativa*, Asteraceae; Icegerg A), Tomato (*Lycopersicon sculentum*, Solanaceae; Burpees Big Boy Hybrid), and Cucumber (*Cucumis sativus*, Cucurbitaceae; Staight Eight); *EPA recommends six dicots in four families, including soybean and a root crop.*

OECD recommends a minimum of three species selected for testing, at least one from each of the following categories: Category 1: ryegrass, rice, oat, wheat, and sorghum; Category 2: mustard, rape, radish, turnip, and Chinese cabbage; Category 3: vetch, mung bean, red clover, fenugreek, lettuce, and cress.

Seed source: Onion, corn, carrot, cabbage, lettuce, cucumber and tomato obtained from Burpee Seed Company; Soybean obtained from Johnny's Select Seeds; Oat obtained from Sprout People; and Perennial ryegrass obtained from Pennington Seed Inc.
Prior seed treatment/sterilization: The seeds were not treated with any type of fungicides, insecticides, or any pesticides.
Historical % germination of seed: Germination rates were not reported.
Seed storage, if any: Not reported.

B. STUDY DESIGN:

1. Experimental Conditions

a. Limit test: None.

b. Range-finding study: None.

c. Definitive Study

Table 3: Experimental Parameters – Vegetative Vigor.

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Duration of the test	14 days	*Recommended test duration is 14-21 days.* *OECD recommends that the test be terminated no sooner than 14 days after 50 percent of the control seedlings have emerged*
Number of seeds/plants/species/ replicate	One plant per container planted in a peat pellet; 36 total containers per treatment rate. For analysis purposes, the study author grouped the containers in groups of 12 containers, creating 3 replicates of 12 seedlings each per treatment rate.	*Five plants per replicate are recommended.*
Number of plants retained after thinning	N/A- thinning was not performed	
<u>Number of replicates</u> Control: Adjuvant control: Treated:	3 N/A 3	*Four replicates per dose should be used.* *OECD recommends a minimum of four replicates per treatment*

Data Evaluation Record on the Acute Toxicity of Avenger Weed Killer Concentrate (a.i. d-limonene) to Terrestrial Vascular Plants: Vegetative Vigor

PMRA Submission Number {.....} **EPA MRID Number 49098302**

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Test concentrations (lb ai/A) Nominal: Measured:	Nominal concentration: 0 (negative), 6.4, 13, 26, 51, and 103 lb ai/A. Cabbage 7, 10, 30, 54, and 85 lb ai/A; carrot 6, 13, 25, 71, and 109 lb ai/A; corn 8, 13, 31, 79, and 101 lb ai/A; cucumber 7, 15, 28, 62, and 79 lb ai/A; lettuce 7, 13, 31, 61, and 128 lb ai/A; oat 15, 18, 25, 71, and 153 lb ai/A; onion 6, 14, 33, 39, and 87 lb ai/A; ryegrass 6, 12, 24, 47, and 115 lb ai/A; soybean 7, 9, 25, 41, and 69 lb ai/A and tomato 7, 13, 30, 52 and 58 lb ai/A.	*Five test concentrations should be used with a dose range of 2X or 3X progression* *OECD recommends three concentrations, preferably with application rates equivalent to 0.0 (control), 1.0, 10.0 and 100 mg substance per kg of oven-dried soil.*
Method and interval of analytical verification LOQ: LOD:	Not reported. N/A N/A	
Adjuvant (type, percentage, if used)	N/A	
Test container (pot) Size/Volume Material: (glass/polystyrene)	Thirty six containers/peat pellets per tray; containers were ca. 7.6 x 7.6 x 7.6 cm. Not reported	*Non-porous containers should be used.* *OECD recommends that non-porous plastic or glazed pot be used.*
Growth facility	Hoods with time controlled light cycles.	
Method/depth of seeding	Not reported.	
Test material application Application time including		

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
the plant growth stage Number of application Application interval Method of application	Not reported. 1 N/A- single application The test material emulsified in tap water was applied over the seedling containers in each tray (not further described).	
<u>Details of soil used</u> Geographic location Depth of soil collection Soil texture % sand % silt % clay pH: % organic carbon CEC Moisture at 1/3 atm (%)	 N/A N/A Peat Pellets Not reported Not reported Not reported 6.12 Not reported Not reported Not reported	Jiffy Peat Pellets; Mfg by Jiffy Products LTD, Shippagan, NB, Canada. Organic matter: Not reported *Soil mixes containing sandy loam, loam, or clay loam soil with no greater than 2% organic matter are preferable. Glass beads, rock wool, and 100% acid washed sand are not preferred.* *OECD prefers the soil to be sieved (0.5 cm) to remove coarse fragments. Carbon content should not exceed 1.5% (3% organic matter). Fine particles (under 20um) makeup should be between 10 and 20%. The recommended pH is between 5.0 and 7.5.*
Details of nutrient medium, if used	N/A	
<u>Watering regime and schedules</u> Water source/type: Volume applied: Interval of application: Method of application:	 Tap water (not characterized) Not reported. Once or twice daily. Automatic sprinkler with misting nozzles that delivered 0.6 gallons/minute.	 *EPA prefers that bottom watering be utilized for seedling emergence studies so that the chemical is not leached out of the soil during the test.*
Any pest control method/fertilization, if used	None reported	

Parameters	Vegetative Vigor	
	Details	**Remarks** ***Criteria***
Test conditions Temperature: Photoperiod: Light intensity and quality: Relative humidity:	12.4-24.5˚C 16L:8D Full spectrum grow lights. 202-1727 Lux 53.8-98.9%	*EPA prefers that the cold vs warm loving plants be tested in two separate groups to optimize plant growth.* *OECD prefers that the temperature, humidity and light conditions be suitable for maintaining normal growth of each species for the test period.*
Reference chemical (if used) Name: Concentrations:	N/A	
Other parameters, if any	None	

2. Observations:

Table 4: Observation Parameters – Vegetative Vigor.

Parameters	Vegetative Vigor	
	Details	**Remarks**
Parameters measured (e.g., number of germinated seeds, emerged seedlings, plant height, dry weight or other endpoints)	- Mortality - Height - Dry weight - Phytotoxicity	The study author also measured plant diameter.
Measurement technique for each parameter	Mortality and phytotoxicity were visually determined. Height measurement was not described. Seedlings were placed in drying oven by replicate until dried and dry weight recorded for each replicate (not further defined).	
Observation intervals	Each pot was inspected daily and phytotoxicity	

	assessments performed. Plant height and dry weight were recorded at study termination.	
Other observations, if any	N/A	
Were raw data included?	Yes	
Phytotoxicity rating system, if used	0- Normal, healthy; 1- localized discoloration; 2 – widespread (<50%) discoloration of plants and/or leaves; 3- widespread (>50%) discoloration, some signs of wilting; 4 – Plant/leaves mostly brown, noticeable wilting and necrosis; 5 – Plant dead, completely brown and wilted and necrotic.	.

II. RESULTS and DISCUSSION:

A. INHIBITORY EFFECTS:

1. Vegetative Vigor:

Negative control survival ranged from 97 to 100%. All species had 100% inhibition at the highest test concentration, with the exceptions of lettuce (89% inhibition), oat (18% inhibition), and onion (72% inhibition) compared to the negative control ($p<0.05$). Soybean had no mortalities; however, there was a significant effect on phytotoxicity scores at the highest test concentration ($p<0.05$). The reviewer found similar results.

There were significant, generally dose-dependent responses in height beginning at the 6 lb ai/A test level (0.5%) for lettuce and cucumber; beginning at 13 lb ai/A (1%) for cabbage and corn; beginning at 26 lb ai/A (2%) for carrot, oat, and ryegrass (ANOVA with Tukey's; $p<0.05$). There was also a significant reduction for onion at the 103 lb ai/A (8%) treatment level ($p<0.05$). There were no significant responses in height for soybeans or tomato (based on all treatment except the highest, in which all tomato seedlings died). Also, based on the reviewer's analysis, the responses for lettuce and oat were not dose-dependent (Dunnett's test $p<0.5$).

There were significant, generally dose-dependent responses in weight beginning at the 6 lb ai/A test level (0.5%) for cabbage; beginning at 13 lb ai/A (1%) for carrot, corn, cucumber and soybean; beginning at 26 lb ai/A (2%) for oat and ryegrass; and at 51 lb ai/A (4%) for onion ($p<0.05$). There was also a significant reduction for lettuce at the 103 lb ai/A (8%) treatment level (ANOVA with Tukey's; $p<0.05$). There were no significant responses in weight for tomato (based on all treatment except the highest, in which all tomato

seedlings died). Also, based on the reviewer's analysis, the responses for lettuce, oat, onion and ryegrass were not dose-dependent.

The most sensitive monocot, based on the study author's results, was ryegrass with NOAEC and EC_{25} values of 13 lb ai/A (1%) and 28 lb ai/A (2.2%), respectively. The most sensitive dicot, based on the study author's results, was cabbage and carrot with NOAEC and EC_{25} values of 26 lb ai/A (2%) and 41 lb ai/A (3.2%), respectively.

Based on the phytotoxicity rating system used by the study author, there were significant responses for all species that mirrored the survival data. There were no significant effects on negative controls or at any treatment level for any of the species studied.

B. REPORTED STATISTICS:

Replicate shoot length, dry weight, phytotoxicity scores were analyzed (GraphPad InStat version 3.06 for Windows 95). Phytotoxicity ratings were converted to percent using the arcsin method prior to statistical comparison. All datasets were further analyzed using ANOVA with Tukey's for phytotoxicity scores, dry weights and height. NOEC, LOEC and ECx values were determined from day 14 mortality using ToxCalc (version 5.0). The maximum likelihood probit model was used to determine the effective concentrations NOEC and LOEC. All calculations were based on nominal application rates and percent inhibitions calculated based on the negative control.

Table 5: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for height (lbs ai/A)									
	height (cm)	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	18.2-126	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Carrot[2]	29.2-147	13	ND	ND	ND	ND	ND	ND	N/A	N/A
Corn[3]	15.8-415	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Cucumber[4]	30.7-161	<6	ND	ND	ND	ND	ND	ND	N/A	N/A
Lettuce[5]	64-157	<6	ND	ND	ND	ND	ND	ND	N/A	N/A
Oat[6]	313-477	13	ND	ND	ND	ND	ND	ND	N/A	N/A
Onion[7]	13-160	≥103	ND	ND	ND	ND	ND	ND	N/A	N/A
Ryegrass[8]	112-366	13	ND	ND	ND	ND	ND	ND	N/A	N/A
Soybean[9]	146-316	≥103	ND	ND	ND	ND	ND	ND	N/A	N/A
Tomato[10]	162-259	13	ND	ND	ND	ND	ND	ND	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
2 There was a significant reduction for carrot at the 26 lb ai/A test level compared to the negative control ($p<0.05$).
3 There was a significant reduction for corn at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
4 There was a significant reduction for cucumber at the 6 lb ai/A test level compared to the negative control ($p<0.05$).
5 There was a significant reduction for lettuce at the 6 lb ai/A test level compared to the negative control ($p<0.05$).
6 There was a significant reduction for oat at the 26 lb ai/A test level compared to the negative control ($p<0.05$).
7 There was a significant reduction for onion at the 103 lb ai/A test level compared to the negative control ($p<0.05$).
8 There was a significant reduction for ryegrass at the 26 lb ai/A test level compared to the negative control ($p<0.05$).
9 There was no significant reduction for soybean compared to the negative control.
10 There was a significant reduction for tomato at the 26 lb ai/A test level compared to the negative control ($p<0.05$)..

Table 5a: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for biomass (lbs ai/A)									
	weight (g)	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	0.0867-0.171	<6	ND	ND	ND	ND	ND	ND	N/A	N/A
Carrot[2]	0.0073-0.0469	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Corn[3]	0.074-0.23	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Cucumber[4]	0.154-0.306	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Lettuce[5]	0.0636-0.269	≥103	ND	ND	ND	ND	ND	ND	N/A	N/A
Oat[6]	0.0738-0.192	13	ND	ND	ND	ND	ND	ND	N/A	N/A
Onion[7]	0.00248-0.0184	26	ND	ND	ND	ND	ND	ND	N/A	N/A
Ryegrass[8]	0.0327-0.0905	13	ND	ND	ND	ND	ND	ND	N/A	N/A
Soybean[9]	0.117-0.301	6	ND	ND	ND	ND	ND	ND	N/A	N/A
Tomato[10]	0.0997-0.202	51	ND	ND	ND	ND	ND	ND	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage at the 6 lb ai/A test level compared to the negative control ($p<0.05$).
2 There was a significant reduction for carrot at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
3 There was a significant reduction for corn at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
4 There was a significant reduction for cucumber at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
5 There was a significant reduction for lettuce at the 103 lb ai/A test level compared to the negative control ($p<0.05$).
6 There was a significant reduction for oat at the 26 lb ai/A test level compared to the negative control ($p<0.05$).
7 There was a significant reduction for onion at the 51 lb ai/A test level compared to the negative control ($p<0.05$).
8 There was a significant reduction for ryegrass at the 26 lb ai/A test level compared to the negative control ($p<0.05$).
9 There was a significant reduction for soybean at the 13 lb ai/A test level compared to the negative control ($p<0.05$).
10 There were no significant reduction for tomato; however,all seedlings at the highest application rate died.

Table 5b: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for survival (lbs ai/A)									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	0-100	26	30	ND	41	ND	50	ND	N/A	N/A
Carrot[2]	0-100	26	30	ND	41	ND	50	ND	N/A	N/A
Corn[3]	0-100	13	30	ND	41	ND	50	ND	N/A	N/A
Cucumber[4]	0-100	NC	NC	ND	NC	ND	52	ND	N/A	N/A
Lettuce[9]	11-100	26	36	ND	51	ND	66	ND	N/A	N/A
Oat[10]	47-100	13	17	ND	47	ND	95	ND	N/A	N/A
Onion[5]	28-100	51	26	ND	57	ND	98	ND	N/A	N/A
Ryegrass[6]	0-100	13	18	ND	28	ND	3.04	ND	N/A	N/A
Soybean[7]	100	≥103	NC	ND	NC	ND	NC	ND	N/A	N/A
Tomato[8]	0-100	NC	NC	ND	NC	ND	52-103	ND	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage at the 51 lb ai/A test level compared to the negative control ($p<0.05$).

2 There was a significant reduction for carrot at the 51 lb ai/A test level compared to the negative control ($p<0.05$).

3 There was a significant reduction for corn at the 26 lb ai/A test level compared to the negative control ($p<0.05$).

4 Effective concentration for cucumber could not be calculated. Probit requires at least two partial responses; estimated EC_{50} from mortality tables.

5 There was a significant reduction for onion of at the 103 lb ai/A test level compared to the negative control ($p<0.05$).

6 There was a significant reduction for ryegrass at the 26 lb ai/A test level compared to the negative control ($p<0.05$).

7 All soybeans survived, therefore ECx was not applicable. Note that according to the study data, in fact only 47% soybeans in the highest treatment level had a reported height measurement the rest were too brittle to measure.

8 Effective concentration for tomato could not be calculated. Probit requires at least two partial responses; estimated EC_{50} from mortality tables.

9 There was a significant reduction for lettuce at the 51 lb ai/A test level compared to the negative control ($p<0.05$).

10 There was a significant reduction for oat at the 26 lb ai/A test level compared to the negative control ($p<0.05$).

Plant Injury Index*											
Control	Cabbage	Carrot	Corn	Cucumber	Lettuce	Oat	Onion	Rye	Soybean	Tomato	Formulation Blank
0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-4	0-5	NA

0- Normal, healthy; 1- localized discoloration; 2 – widespread (<50%) discoloration of plants and/or leaves; 3- widespread (>50%) discoloration, some signs of wilting; 4 – Plant/leaves mostly brown, noticeable wilting and necrosis; 5 – Plant dead, completely brown and wilted and necrotic; DNE – Did not emerge.

C. VERIFICATION OF STATISTICAL RESULTS BY THE REVIEWER:

All analyses were conducted comparing treated to the negative control. These analyses were conducted using CETIS version 1.8.7.12 and backend settings approved for use by EFED on 5/31/13. Data for each endpoint were tested to determine if their distributions were normal and if their variances were homogeneous using Shapiro-Wilk's and Levene's tests, respectively. Data that satisfied these assumptions were subjected to Dunnett's and William's tests, and data that did not satisfy these assumptions were subjected to the non-parametric MannWhitney-U and Jonckheere's tests. Survival was further analysed by Spearman-Karber when appropriate. Measured concentrations were used for all analyses.

Table 6: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for height (lbs ai/A)									
	height (cm)	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	18.2-126	7	12.9	N/A-17.6	22.1	16.7-27.2	32.2	28.4-36.5	N/A	N/A
Carrot[2]	29.2-147	13	11.1	N/A-17.2	23	15.6-30.6	38.2	31-47.1	N/A	N/A
Corn[3]	15.8-415	8	5.05	N/A-8.04	10.5	8.26-12.8	17.6	15-20.5	N/A	N/A
Cucumber[4]	30.7-161	<7	3.61	N/A-7.56	11.2	7.55-15.4	24.6	20-30.2	N/A	N/A
Lettuce[5]	64-157	<7	0.312	N/A-3.43	8.3	2.61-21.2	81.2	43.2-152	N/A	N/A
Oat[6]	313-477	18	4.16	N/A-30.6	69.7	27.2-150	495	46-5330	N/A	N/A
Onion[7]	13-160	39	>87	N/A	>87	N/A	>87	N/A	N/A	N/A
Ryegrass[8]	112-366	12	7.21	N/A-10.7	16.2	12.6-20	28.6	25-32.6	N/A	N/A
Soybean[9]	146-316	41	>69	N/A	>69	N/A	>69	N/A	N/A	N/A
Tomato[10]	162-259	52	>58	N/A	>58	N/A	>58	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage of 21, 47, and 86% at the 10, 30 and 54 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

2 There was a significant reduction for carrot of 10, 27 and 80% at the 13, 25 and 71 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

3 There was a significant reduction for corn of 30, 81 and 96% at the 13, 31 and 78 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

4 There was a significant reduction for cucumber of 20, 37, 50 and 81% at the 7, 15, 28 and 62 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

5 There was a significant reduction for lettuce of 36, 28, 27, 51 and 59% at the 7, 13, 31, 61 and 128 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$).

6 There was a significant reduction for oat of 65, 29 and 27% at the 25, 71 and 152 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$).

7 There was a significant reduction for onion of 92% at the 87 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$); however, the 95% confidence intervals were either not reliable or not calculable. Therefore, the responses were not considered a valid reflection of a dose-response and appeared to be related to the very poor survival rate at the highest treatment level.

8 There was a significant reduction for ryegrass of 48 and 69% at the 24 and 47 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a dose-dependent response.

9 There was a significant reduction for soybean of 52% at the 69 lb ai/A test level compared to the negative control (Mann-Whitney Wilcoxon test; $p<0.05$); however, the 95% confidence intervals were either not reliable or not calculable. Therefore, the responses were not considered a valid reflection of a dose-response and appeared to be related to the very poor survival rate at the highest treatment level.

10 There were no significant reduction for tomato; however all seedlings at the highest application rate died; therefore the NOEC is 52 lb ai/A.

Table 6a: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for biomass (lbs ai/A)									
	weight (g)	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	0.0867-0.171	<7	1.31	N/A-4.87	7.09	3.37-12.6	22.9	15.9-33.1	N/A	N/A
Carrot[2]	0.0073-0.0469	6	4.5	N/A-7.83	12.2	9.11-15.5	24.3	20.5-28.9	N/A	N/A
Corn[3]	0.074-0.23	<8	0.19	N/A-3.07	2.83	0.21-12.7	18.6	9.56-36.3	N/A	N/A
Cucumber[4]	0.154-0.306	<7	0.457	N/A-3.17	7.3	2.79-15.9	50	28.7-87.1	N/A	N/A
Lettuce[5]	0.0636-0.269	<7	NC	N/A	NC	N/A	NC	N/A	N/A	N/A
Oat[6]	0.0738-0.192	25	0.156	N/A-148	21.8	0.432-260	>152	N/A	N/A	N/A
Onion[7]	0.00248-0.0184	39	28.3	N/A-49.1	42.8	24.6-55.8	57.1	45.7-71.3	N/A	N/A
Ryegrass[8]	0.0327-0.0905	12	2.87	N/A-10.3	11.5	4.5-21.6	30.1	19.4-46.8	N/A	N/A
Soybean[9]	0.117-0.301	<7	21.4	N/A-31.6	40.8	30.3-51.1	63.9	53.7-78.1	N/A	N/A
Tomato[10]	0.0997-0.202	52	>58	N/A	>58	N/A	>58	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage of 19, 28, 67 and 49% at the 7, 10, 30, and 54 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). Despite a slightly higher weight at the 54 lb ai/A (last concentration with surviving seedlings); the response was generally dose-dependent.

2 There was a significant reduction for carrot of 28, 50 and 84% at the 13, 25, and 71 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

3 There was a significant reduction for corn of 23, 53, 68 and 63% at the 8, 13, 31, and 78 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

4 There was a significant reduction for cucumber of 22, 31, 49 and 50% at the 7, 15, 28, and 62 lb ai/A test level compared to the negative control (Williams test; $p<0.05$). There was a clear dose-dependent response.

5 There was a significant reduction for lettuce of 48% at the 7 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$); there was an anomalous data point at the highest treatment level due to the replicate consisting of only one surviving plant.

6 There was a significant reduction for oat of 62% at the 71 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$).

7 There was a significant reduction for onion of 79% at the 87 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$); however, the responses were not considered a valid reflection of a dose-response and appeared to be related to the very poor survival rate at the highest treatment level.

8 There was a significant reduction for ryegrass of 64 and 53% at the 24 and 47 lb ai/A test level compared to the negative control (Dunnett's test; $p<0.05$). There was not a dose-dependent response.

9 There was a significant reduction for soybean of 20, 32, 16, 41 and 61% at the 7, 9, 25, 41, and 69 lb ai/A test level (William's test; $p<0.05$).

10 There were no significant reduction for tomato; however all seedlings at the highest application rate died; therefore the NOEC is 52 lb ai/A.

Table 6b: Effect of Limonene on 14-Day Vegetative Vigor

Species	Results summary for survival (lbs ai/A)									
	%	NOEC	EC_{05}	95%CI	EC_{25}	95%CI	EC_{50}	95%CI	slope	95%CI
Cabbage[1]	0-100	30	>85	N/A	>85	N/A	40.1	37-43.5	N/A	N/A
Carrot[2]	0-100	25	>109	N/A	>109	N/A	60.1	52.9-68.4	N/A	N/A
Corn[3]	0-100	13	>101	N/A	>101	N/A	29.1	24.8-34.1	N/A	N/A
Cucumber[4]	0-100	28	>79	N/A	>79	N/A	53.2	48.8-58	N/A	N/A
Lettuce[9]	11-100	31	44	30.1-53.9	63	50.6-72.5	80.8	69.8-92.8	6.24	4.04-8.44
Oat[10]	47-100	18	>152	N/A	>152	N/A	142	97.2-207	N/A	N/A
Onion[5]	28-100	39	>87	N/A	>87	N/A	67.6	60.2-76	N/A	N/A
Ryegrass[6]	0-100	12	>115	N/A	>115	N/A	37.6	32-44.1	N/A	N/A
Soybean[7]	100	69	>69	N/A	>69	N/A	>69	N/A	N/A	N/A
Tomato[8]	0-100	52	>58	N/A	>58	N/A	>58	N/A	N/A	N/A

ND- Not determined. NC- Not calculable.

1 There was a significant reduction for cabbage of 92 and 100% at the 54 and 85 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

2 There was a significant reduction for carrot of 49 and 100% at the 71 and 109 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

3 There was a significant reduction for corn of 64, 89, and 100% at the 31, 78 and 101 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

4 There was a significant reduction for cucumber of 53 and 100% at the 62 and 79 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

5 There was a significant reduction for onion of 72% at the 87 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

6 There was a significant reduction for ryegrass of 25, 64 and 100% at the 24, 47 and 115 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

7 There were no significant reductions for soybean at any level compared to the negative control.

8 There was a significant reduction for tomato of 100% at the 58 lb ai/A test level compared to the negative control (Mann-Whitney; $p<0.05$).

9 There was a significant reduction for lettuce of 23 and 89% at the 61 and 128 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

10 There was a significant reduction for oat of 21, 62 and 18% at the 25, 71 and 152 lb ai/A test level compared to the negative control (Spearman-Karber; $p<0.05$).

Plant Injury Index*											
Control	Cabbage	Carrot	Corn	Cucumber	Lettuce	Oat	Onion	Rye	Soybean	Tomato	Formulation Blank
0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-5	0-4	0-5	NA

0- Normal, healthy; 1- localized discoloration; 2 – widespread (<50%) discoloration of plants and/or leaves; 3- widespread (>50%) discoloration, some signs of wilting; 4 – Plant/leaves mostly brown, noticeable wilting and necrosis; 5 – Plant dead, completely brown and wilted and necrotic; DNE – Did not emerge.

Most sensitive monocot: Corn, based on dry weight

EC_{50}/IC_{50}: 18.6 lb ai/A 95% C.I.: 9.56-36.3 lb ai/A
EC_{25}/IC_{25}: 2.83 lb ai/A 95% C.I.: 0.21-12.7 lb ai/A
EC_{05}/IC_{05}: 0.19 lb ai/A 95% C.I.: N/A-3.07 lb ai/A
NOEC: <8 lb ai/A
Slope: N/A 95% C.I.: N/A

Most sensitive dicot: Cabbage, based on dry weight

EC_{50}/IC_{50}: 22.9 lb ai/A 95% C.I.: 15.9-33.1 lb ai/A
EC_{25}/IC_{25}: 7.09 lb ai/A 95% C.I.: 3.37-12.6 lb ai/A
EC_{05}/IC_{05}: 1.31 lb ai/A 95% C.I.: N/A-4.87 lb ai/A
NOEC: <7 lb ai/A
Slope: N/A 95% C.I.: N/A

D. STUDY DEFICIENCIES:

There were no study deficiencies.

E. REVIEWER'S COMMENTS:

The reviewer's and the study author's results for the most sensitive monocot and dicot were in general agreement; however, the reviewer found corn to be the most sensitive monocot. The study author based the NOEC and ECx values for most sensitive species on phytotoxicity (included mortality) scores only. The reviewer's toxicity values are reported in the Executive Summary and Conclusions sections of this DER.

The environmental conditions did not follow USEPA guideline specifications defined as: day temperature 25±6ºC/night temperature 20±6ºC, humidity 70±15% and lighting 350±50 µmol/m^2/sec.

The in-life portion of the test was conducted from November 19, 2012 to February 18, 2013.

F. CONCLUSIONS:

This study is classified as ACCEPTABLE. The most sensitive monocot was corn, based on dry weight, with NOAEC and EC_{25} values of <8 lb ai/A, and 2.83 lb ai/A, respectively. The most sensitive dicot was cabbage, based on dry weight, with NOAEC and EC_{25} values of <7 lb ai/A, and 7.09 lb ai/A, respectively.

Most sensitive monocot and EC_{25}: Corn, 2.83 lb ai/A.
Most sensitive dicot and EC_{25}: Cabbage, 7.09 lb ai/A.

III. REFERENCES:

None.

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Stillmeadow, Inc.**

Batch ID:	15-2477-9846	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	19 Nov-12	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	14 Feb-14 18:56	**Species:**	Brassica oleracea	**Brine:**	
Duration:	452d 19h	**Source:**	Burpee, NC	**Age:**	

Sample ID:	21-3759-6411	**Code:**	49098302 cabbag	**Client:**	EPA OCSPP EFED
Sample Date:	19 Nov-12	**Material:**	Limonene	**Project:**	
Receive Date:	14 Feb-14 18:56	**Source:**	Cutting Edge Formulation		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
09-5144-7448	Height	7	10	8.367	21.9%		Dunnett Multiple Comparison Test
02-2015-5627	Height	7	10	8.367	16.8%		Williams Multiple Comparison Test
02-3617-7407	Survival	30	54	40.25	NA		Jonckheere-Terpstra Step-Down Test
18-9886-3061	Survival	30	54	40.25	12.3%		Mann-Whitney U Two-Sample Test
10-0797-7945	Weight	<7	7	NA	14.2%		Dunnett Multiple Comparison Test
00-3263-6292	Weight	<7	7	NA	16.5%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
08-3255-9961	Height	IC5	12.9	N/A	17.6		Nonlinear Regression
		IC10	15.8	N/A	20.7		
		IC25	22.1	16.7	27.2		
		IC50	32.2	28.4	36.5		
12-3739-6413	Survival	EC50	40.1	37	43.5		Spearman-Kärber
06-1281-0660	Weight	IC5	1.31	N/A	4.87		Nonlinear Regression
		IC10	2.47	N/A	6.33		
		IC25	7.09	3.37	12.6		
		IC50	22.9	15.9	33.1		

Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	126	91.3	161	110	136	8.05	13.9	11.1%	0.0%
7		3	119	106	132	113	123	3.03	5.24	4.39%	5.24%
10		3	99.4	89.9	109	97	104	2.2	3.82	3.84%	21.1%
30		3	66.5	40.9	92.1	54.7	73.5	5.95	10.3	15.5%	47.2%
54		1	18.2			18.2	18.2	0	0	0.0%	85.5%

Survival Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	1	1	1	1	1	0	0	0.0%	0.0%
7		3	1	1	1	1	1	0	0	0.0%	0.0%
10		3	1	1	1	1	1	0	0	0.0%	0.0%
30		3	0.944	0.705	1	0.833	1	0.0556	0.0962	10.2%	5.56%
54		3	0.0833	0	0.442	0	0.25	0.0833	0.144	173.0%	91.7%
85		3	0	0	0	0	0	0	0		100.0%

Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	0.171	0.154	0.189	0.164	0.178	0.00401	0.00695	4.06%	0.0%
7		3	0.138	0.0922	0.184	0.124	0.159	0.0107	0.0186	13.4%	19.3%
10		3	0.124	0.0886	0.16	0.116	0.141	0.00829	0.0144	11.5%	27.5%
30		3	0.0566	0.0479	0.0654	0.0543	0.0607	0.00204	0.00353	6.23%	67.0%
54		1	0.0867			0.0867	0.0867	0	0	0.0%	49.4%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Stillmeadow, Inc.**

Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	110	136	131
7		123	113	122
10		104	97.4	97
30		54.7	71.4	73.5
54				18.2
85				

Survival Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	1	1	1
7		1	1	1
10		1	1	1
30		0.833	1	1
54		0	0	0.25
85		0	0	0

Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.178	0.172	0.164
7		0.159	0.124	0.132
10		0.141	0.116	0.116
30		0.0543	0.0548	0.0607
54				0.0867
85				

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Stillmeadow, Inc.**

Batch ID:	08-1152-3620	**Test Type:**	Vegetative Vigor Tier II	**Analyst:**	
Start Date:	19 Nov-12	**Protocol:**	OCSPP 850.4150 Plant Vegetative Vigor	**Diluent:**	
Ending Date:	14 Feb-14 19:12	**Species:**	Zea mays	**Brine:**	
Duration:	452d 19h	**Source:**	Burpee, NC	**Age:**	

Sample ID:	12-5658-5351	**Code:**	49098302 corn	**Client:**	EPA OCSPP EFED
Sample Date:	19 Nov-12	**Material:**	Limonene	**Project:**	
Receive Date:	14 Feb-14 19:12	**Source:**	Cutting Edge Formulation		
Sample Age:	NA	**Station:**			

Comparison Summary

Analysis ID	Endpoint	NOEL	LOEL	TOEL	PMSD	TU	Method
01-1728-1474	Height	8	13	10.2	14.2%		Dunnett Multiple Comparison Test
17-7498-7173	Height	8	13	10.2	11.3%		Williams Multiple Comparison Test
18-4129-9959	Survival	13	31	20.07	9.83%		Dunnett Multiple Comparison Test
07-3732-6973	Survival	13	31	20.07	7.57%		Williams Multiple Comparison Test
14-3190-1029	Weight	8	13	10.2	29.8%		Dunnett Multiple Comparison Test
20-5381-8586	Weight	<8	8	NA	23.6%		Williams Multiple Comparison Test

Point Estimate Summary

Analysis ID	Endpoint	Level		95% LCL	95% UCL	TU	Method
00-0441-1032	Height	IC5	5.05	N/A	8.04		Nonlinear Regression
		IC10	6.65	3.04	9.02		
		IC25	10.5	8.26	12.8		
		IC50	17.6	15	20.5		
10-5245-6890	Survival	EC5	12.3	8.81	15.4		Linear Regression (MLE)
		EC10	15	11.3	18.4		
		EC25	21	17	24.9		
		EC50	30.5	25.8	35.9		
01-2617-6720	Survival	EC50	29.1	24.8	34.1		Spearman-Kärber
09-8553-9607	Weight	IC5	0.188	N/A	3.07		Nonlinear Regression
		IC10	0.519	N/A	4.76		
		IC25	2.83	0.21	12.7		
		IC50	18.6	9.56	36.3		

Height Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	415	365	465	393	431	11.6	20.1	4.84%	0.0%
8		3	388	312	464	361	421	17.7	30.6	7.9%	6.6%
13		3	290	177	404	244	335	26.4	45.7	15.7%	30.1%
31		3	80.9	16.2	146	62.6	111	15	26	32.2%	80.5%
78		3	15.8	-17.9	49.5	7.7	31.5	7.84	13.6	85.7%	96.2%

Survival Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	1	1	1	1	1	0	0	0.0%	0.0%
8		3	1	1	1	1	1	0	0	0.0%	0.0%
13		3	0.972	0.853	1	0.917	1	0.0278	0.0481	4.95%	2.78%
31		3	0.361	0.122	0.6	0.25	0.417	0.0556	0.0962	26.6%	63.9%
78		3	0.111	0	0.231	0.0833	0.167	0.0278	0.0481	43.3%	88.9%
101		3	0	0	0	0	0	0	0		100.0%

Weight Summary

Group	Control Type	Count	Mean	95% LCL	95% UCL	Min	Max	Std Err	Std Dev	CV%	%Effect
0	Negative Control	3	0.23	0.0902	0.37	0.172	0.284	0.0325	0.0563	24.5%	0.0%
8		3	0.178	0.0928	0.263	0.146	0.214	0.0198	0.0343	19.3%	22.7%
13		3	0.109	0.0627	0.155	0.0922	0.129	0.0107	0.0185	17.0%	52.8%
31		3	0.074	-0.00733	0.155	0.0462	0.11	0.0189	0.0327	44.2%	67.9%
78		3	0.0857	0.0728	0.0986	0.0803	0.0907	0.00301	0.00521	6.08%	62.8%

OCSPP 850.4150 Terrestrial Plant Tier II (Vegetative Vigor) **Stillmeadow, Inc.**

Height Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	422	431	393
8		381	421	361
13		244	335	292
31		111	62.6	69.4
78		7.7	8.3	31.5
101				

Survival Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	1	1	1
8		1	1	1
13		0.917	1	1
31		0.417	0.25	0.417
78		0.0833	0.0833	0.167
101		0	0	0

Weight Detail

Group	Control Type	Rep 1	Rep 2	Rep 3
0	Negative Control	0.284	0.235	0.172
8		0.146	0.174	0.214
13		0.0922	0.105	0.129
31		0.11	0.0656	0.0462
78		0.0907	0.0861	0.0803
101				